

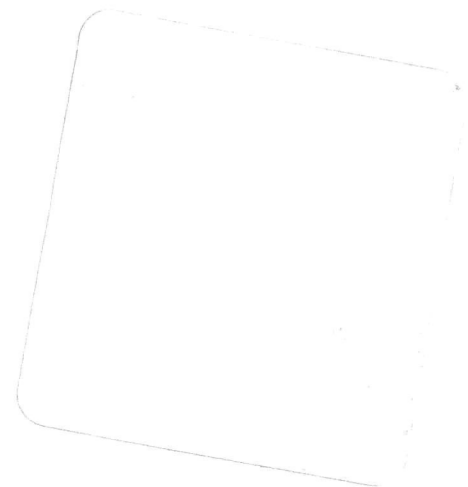
Endodontology – epidemiologic considerations

Eriksen HM. Endodontology – epidemiologic considerations. *Endod Dent Traumatol* 1991; 7: 189–195.

Abstract – The limited information available from endodontic epidemiologic research indicates an increase in prevalence of apical periodontitis with increasing age. Furthermore, apical periodontitis seems mainly to be present in connection with already endodontically treated teeth. This finding should be of particular concern since there is a discrepancy between the quality and results of endodontic therapy performed in general practice compared with the results obtained in specialty clinics. Pulpitis and acute apical periodontitis are main reasons for seeking emergency treatment and affect many people. Dental trauma frequently involving the dentin/pulp organ are likewise prevalent, affecting 30% of children and adolescents. Most information available regarding endodontic treatment is derived from well-controlled clinical studies performed by specialists. Epidemiologic data should be considered a necessary complement to this source of knowledge regarding etiologic factors and proper treatment procedures in order to improve the results of endodontic practice.

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Key words: endodontic treatment; apical periodontitis; epidemiology.

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Accepted for publication December 19, 1990.118

Epidemiology is concerned with the study of disease as it appears in its natural surroundings, and as it affects a community of people rather than a single individual. Epidemiologic research is either descriptive or analytical in its approach. Cross-sectional studies may disclose the health status at a certain time while consecutive cross-sectional studies may reveal trends regarding changes in disease prevalence. Longitudinal studies following the same individuals over time offer the best possibilities for analyzing reasons for changes in health status.

The literature is surprisingly scarce regarding endodontic epidemiology. Major endodontic textbooks (1–8) are generally ignorant about the theme, the only exceptions from this trend are a short presentation by Ingle and coworkers in connection with “The Washington study” (3) and comments on prevalence of dental injuries by Fountain and Camp (9) (a topic well covered by Andreasen in his textbook on dental traumatology (10)). Textbooks in oral pathology (11,12) and radiology (13) are describing in detail aspects of endodontic diseases like apical periodontitis and dental resorptions, but documentation on prevalence of these and other closely related pathologic conditions and scarce or non-existent. Moreover, among textbooks in oral diagnosis (14–16) the only one giving proper atten-

tion to oral epidemiology (14) does not include endodontic epidemiology among its topics. In general, systematic descriptions of symptoms and clinical procedures seem to be of major concern in the literature reviewed (1–16).

There are no indications that this situation is going to change. In a survey among dental schools in the United States regarding endodontic research for the 1980's, endodontic epidemiology is not specifically mentioned among the 35 topics suggested (17). Only two of these topics may indirectly include endodontic epidemiology, i.e. studies in success/failure and clinical studies. Based on a workshop in 1984 considering current guidelines for endodontic teaching programs approved by The American Association of Dental Schools in 1986 (18), endodontic epidemiology is not considered.

Results from national and regional epidemiologic oral health studies are frequently published, both in scientific journals and as monographs or reports (19–25). However, these oral health survey studies do not include a full radiographic examination and endodontic evaluations are therefore impossible. There are, however, some cross-sectional cohort-investigations available including full mouth radiographs. The present survey article will to a large extent be based on these studies. This limits the

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possibilities for generalization, but an indication of trends regarding prevalence of endodontically related problems is possible.

Based on the definition of epidemiology, incidence and prevalence of the following endodontic conditions will be included in the present survey:

- pulpitis and acute apical periodontitis
- dental trauma
- facial pain
- pulp necrosis
- chronic apical periodontitis

Furthermore, prevalence, quality and clinical results of the following endodontic treatment procedures will be included:

- root filling
- partial pulpotomy
- pulp capping
- apicoectomy

Incidence of pulpitis and acute apical periodontitis

Being acute, incidence of pulpitis and acute apical periodontitis are more relevant than prevalence measures based on results from cross-sectional studies. To the author's knowledge, there are only a few longitudinal dental health studies reporting on the incidence of pulpitis and acute apical periodontitis.

The incidence of dental pain over a 4 week-period among a random sample of adults in Toronto, Canada, was reported to be 14% with 7% characterized as moderate/severe pain (26). This figure complies well with two British studies (27,28) while a recent study from 30 dental practices in Denmark (29) concludes that only 2% of the patients seeking dental care presented with dental pain. Although exact estimations are difficult to obtain, it is obvious that pulpitis and acute apical periodontitis constitute a dental health problem even in societies with easy access to dental care.

Recordings from two emergency clinics in Scandinavia (30,31) indicate that about 40% of the diagnoses made were pulpitis and acute apical periodontitis. The most prevalent age-group was 20–40-year-olds. The prevalence found in Scandinavian studies correlates well with recordings of reasons for emergency care among military personnel from Colorado (32). Prevalence of emergency visits for people under regular dental care was reported to be less than 5% (33) which supports the data from Denmark (29). General conclusions can not be drawn from such studies due to demographic bias linked to the utilization of emergency clinics, but they might give an indication of the relative prevalence of pulpitis and apical periodontitis compared to other reasons for seeking emergency care.

The incidence of exacerbations of chronic apical

periodontal lesions is difficult to estimate. Based on our own research on prevalence of apical periodontitis in 50-year-olds (34), there seems to be less than 5% of the total number of chronic periapical lesions present developing into an acute process per year over a 15-year-period (35) which supports the data from other investigations reported (29,33).

Dental trauma

The prevalence and incidence of trauma involving teeth in children and adolescents are extensively documented by Andreasen (10). Thirty percent of Danish school-children are reported to have suffered from dental injuries (36) and this prevalence is increasing (10,36–38). Although the prevalence of dental trauma reported from Denmark seems to be higher than in other countries, this is a world-wide problem (38,39). In an endodontic perspective, 10% of dental trauma involve the pulp and the maxillary central incisors are the most vulnerable (40). Besides being a problem linked to children and adolescents, dental trauma seems to affect an increasing number of adults in connection with sport activities (41).

Facial pain

Facial pain represent a diagnostic challenge. This is reflected in textbooks on facial pain which contain information from a variety of specialties where dentally related topics represent only a part of the field (13–15,42). However, textbooks dealing with oral diagnosis and facial pain are concerned with detailed descriptions of physiology and anatomy related to this complicated region and concentrate on systematic registration of symptoms, differential diagnostic problems and appropriate treatment decisions. Epidemiology of facial pain, both in general and specifically related to oral diseases is not systematically described with the exception of pain in connection with craniomandibular and masticatory dysfunction disorders (43,44). Its multicausal and often obscure etiology offers methodological problems and deserves closer attention both from an endodontic and an epidemiologic point of view (45).

Pulp necrosis and chronic apical periodontitis

Pulp necrosis does not automatically result in an apical periodontitis. A bacterial infection of the necrotic tissue is a prerequisite for apical pathosis to develop (46). Prevalence of apical periodontitis is therefore not a valid measure of pulp necrosis. As sensitivity measures (heat, cold, electricity etc.) are not included in oral health survey studies (19–25),

the prevalence of pulpal necrosis without other pathologic signs is generally unknown.

Knowledge about prevalence of apical periodontitis is important as the ultimate goal of endodontic therapy is to prevent the development of apical periodontitis or, if present, promote its healing. The prevalence of apical periodontitis based on various Scandinavian cohort studies is presented in Table 1 (47–59). As can be seen, the mean number of apical periodontal lesions per person is close to 1. The number is increasing with increasing age and the proportion of affected teeth is increasing even more (Table 1, Fig. 1). About two-thirds of periapical lesions are reported to be related to endodontically treated teeth (34,55–59). In assessing the prevalence of apical periodontitis, one should be aware of the diagnostic problems associated with such lesions (60–62).

Root filling

The reports creating the source for estimation of prevalence of apical periodontitis (34,37–58) are also essential in the estimation of the prevalence of endodontic treatment in society (Table 1) (Fig. 1). Both the prevalence of root fillings and the proportion of remaining teeth with root fillings show an increase with increasing age (Fig. 1). Among 20-year-olds, one out of five persons has a root-filled tooth (53,56) while the average number of root fillings among the dentate 60 to 70-year-olds are four teeth per person even with the reduced number of remaining teeth at this age (53,54). When con-

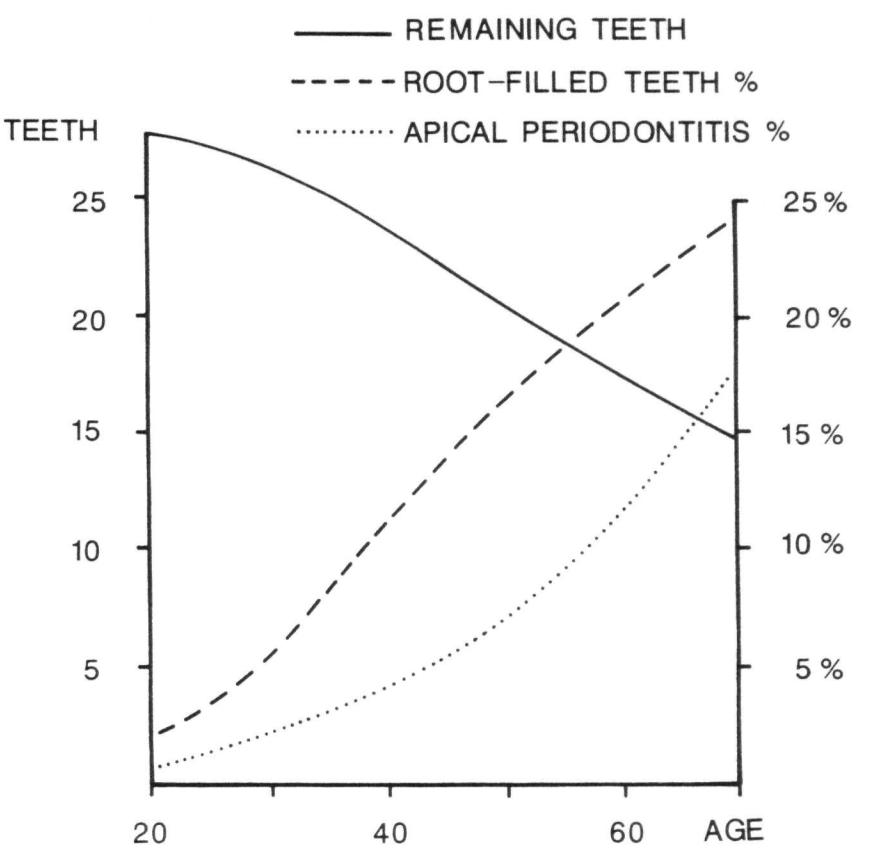


Fig. 1. Root-filled teeth with apical periodontitis given as percent of remaining teeth in various Swedish populations (49,52,53,55). (A similar figure has previously been presented in Ref. 35).

sidering the percentage of remaining teeth among the 60–70-year-olds having a root filling this amounts to 20–25% (Fig. 1). Due to the lack of epidemiologic data from other than Scandinavian countries, information of prevalence and quality of endodontic treatment in various societies is very incomplete.

Available data show a discrepancy between qual-

Table 1. Prevalence of apical periodontitis and root fillings in various cohort studies from Scandinavia (34,47–58).

References	Mean age (range)	Apical periodontitis		Root fillings	
		per person	% of remaining teeth	per person	% of remaining teeth
Bergenholtz et al. (47), 1973	45 (20–> 70)	1.4	6	2.9	13
Kerekes et al. (48), 1976	33 (20–> 60)	0.7	2.8	1.4	6
Axelsson et al. (49), 1977	45 (20–70)	0.9	5	2.5	13
Lavstedt (50), 1978	40 (18–65)	1.2	5	2.5	9
Keiser-Nielsen et al. (51), 1981	42 (25–56)	0.5	2.5	1.8	9
Laurell et al. (52), 1983	45 (20–70)	0.7	3.4	1.6	8
Hugoson et al. (53), 1986	50 (20–80)	1.3	6	1.5	14
Allard et al. (54), 1986	73 (65–> 75)	1.3	9.6	2.5	18
Eckerbom et al. (55), 1987	40 (20–> 60)	1.3	5.2	3.2	13
Eriksen et al. (57), 1988	35	0.4	1.5	0.9	4
Eckerbom et al. (58), 1989	45	1.5	6.3	3.5	15
Eriksen et al. (34), 1990	50	1.6	4.8	2.9	9

ity and results of endodontic treatment performed by general practitioners (34,47–58) and by specialists or supervised students (63–74) (Table 1 and 2) (Fig. 1). While the latter report success rates between 85 and 95%, the frequency of failures in general practice are reported between 25 and 36% (Table 2). This difference in success-rates seems to be intimately linked to quality of the endodontic treatment performed (34,37,54–58,72,74) (Fig. 2).

The lack of standardized criteria for evaluation of

Table 2. Success/failure rates of root fillings performed in general practice and in specialty – or supervised student teaching clinics (34,37–58,63–73).

Reference	Mean age (range)	Success	Uncertain	Failure
<i>General practice</i>				
Bergenholtz et al. (47), 1973	45 (20–>70)	69	–	31
Kerekes et al. (48), 1976	33 (20–>60)	75	–	25
Axelsson et al. (49), 1977	45 (20–70)	75	–	25
Laurell et al. (52), 1983	45 (20–70)	75	–	25
Hugoson et al. (53), 1986	50 (20–80)	70	–	30
Allard et al. (54), 1986	73 (65–70)	73	–	27
Eckerbom et al. (55), 1987	40 (20–>60)	74	–	26
Bergström et al. (56), 1987	41	71	–	29
Eriksen et al. (57), 1988	35	66	–	34
Eckerbom et al. (58), 1989	45	77	–	23
Eriksen et al. (34), 1990	50	64	–	36
<i>Specialty or teaching clinics</i>				
Strindberg (63), 1956		87	3	10
Grahnén et al. (64), 1961	–	83	5	12
Grossman (65), 1964	–	90	1	9
Engström et al. (66), 1965	–	77	6	17
Harty et al. (67), 1970	29 (15–>45)	90	0	10
Molven (68), 1974	42 (15–65)	87	–	13
Jokinen et al. (69), 1978	36 (16–75)	54	12	34
Kerekes et al. (70), 1979	48 (10–80)	91	4	5
Barbakow et al. (71), 1980	–	87	–	13
Ingle* (72), 1985	–	91 94	–	9 6
Ørstavik et al. (73), 1987	46 (20–80)	93	–	7

* The two studies reported are before and after introduction of a standardized technique.

apical periodontitis is a serious limitation regarding comparative analyses of clinical and epidemiologic studies within endodontology. A recently published periapical index (62) represent one effort to overcome diagnostic problems related to apical periodontitis (60,75).

Pulp capping and pulpotomies

An estimation of the prevalence of pulp cappings and pulpotomies can be obtained from epidemiological studies on tooth injuries. It has been reported from Finland that 10% of tooth injuries involve the dental pulp (40) and a majority of these cases might be treated by pulp capping/pulpotomy (76).

The prevalence of pulp capping/pulpotomies in adults is unknown. The long-term prognosis is dubious based on longitudinal clinical studies (77). Pulpotomy in the deciduous dentition is well described and a variety of techniques and materials are used (78), but epidemiologic data from general practice is lacking.

Apicoectomy

Apical surgery is an integral part of endodontic therapy and not an excuse for poor endodontic technique (8). It may be the treatment of choice for various clinical situations including access problems, need for drainage, iatrogenic problems and treatment of refractory cases (1).

Success-rates for apicoectomies performed in specialty clinics are reported to be 85–90% (79–81) while data representative for general practice is lacking.

Frank et al. (8) emphasize that the current concept of endodontic treatment is a non-surgical approach and to follow the progress of therapy by periodic clinical and radiographic examinations.



Fig. 2. Radiographic illustration of difference in technical quality of endodontic treatment before/after revision. This may illustrate one main reason for the difference in success rates reported from specialty clinics and general practice.

This approach is based on controlled clinical investigations, case studies and clinical experience (75). However, this shift towards a more conservative attitude regarding the need for surgical intervention has not been subject to epidemiologic studies and there is no information available to what extent this change in treatment philosophy has influenced dental practice and the overall prognosis for endodontic treatment including apertomies in society.

Comments and discussion

Knowledge about the distribution of disease in society is a necessary complement to the knowledge of etiologic factors, symptomatology, proper treatment and prognosis. Epidemiologic data should constitute an integral part of the basis for current evaluation of concepts for proper treatment, resource allocations and education planning within dentistry. It is therefore disturbing to reveal the limited documentation regarding endodontic epidemiology. This lack of data may be due to a variety of factors such as traditions or "professional culture" in this highly specialized field of dentistry, lack of full-mouth radiographs in epidemiologic survey studies of dental health and/or a biomedical, case-oriented philosophy (82).

The clinical relevance of an epidemiologic approach goes beyond the collection of data for evaluation and planning purposes. As properly emphasized by Reit and Gröndahl (60), an appreciation of an epidemiologic approach to the problems of diagnosis is highly relevant. Furthermore, the prevalence of a disease in society also influences the power of a diagnostic method (83) and the need for clearly defined criteria for the evaluation and comparison of prevalence of periapical radiolucencies is obvious (60,62).

The list of topics considered in the present article focus on major themes within endodontology. Consequently, prevalence of internal and external resorption, periodontal/endodontic problems, transplantation of teeth and other topics could have been included. However, epidemiologic data in these fields are also fragmentary.

Epidemiologic investigations, mainly in Scandinavia, have revealed a substantial discrepancy between the quality of endodontic treatment obtained from well-controlled clinical studies in teaching- and specialty clinics and the level of clinical performance in general practice (Table 2). It would be of interest to see if these results are relevant for other regions as well. Epidemiologic data are essential in the process of analyzing reasons for endodontic failures in general practice and there might be highly relevant qualitative and quantitative variations from one region to another.

The consequences of endodontic failures are pain, discomfort and frequent loss of essential support for fixed or removable prostheses. Epidemiologic data available indicate an increase in prevalence of both root filled teeth and apical periodontitis with increasing age (Fig. 1). This trend should be of great concern to the dental profession as more and more people retain their own teeth into old age.

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